

FORM PTO-1390 (REV 11-2000)	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER 35-222
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S. APPLICATION NO. (if known, see 37 C.F.R. 1.5) 10/030472 UNKNOWN
INTERNATIONAL APPLICATION NO. PCT/EP00/04676	INTERNATIONAL FILING DATE 23 May 2000	PRIORITY DATE CLAIMED 12 July 1999
TITLE OF INVENTION DATA STORAGE MEDIUM		
APPLICANT(S) FOR DO/EO/US LEIBER, J. et al.		
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. 2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. 3. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below. 4. <input checked="" type="checkbox"/> The U.S. has been elected by the expiration of 19 months from the priority date (Article 31). 5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)). a. <input type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau). b. <input checked="" type="checkbox"/> has been communicated by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US). 6. <input checked="" type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)). a. <input checked="" type="checkbox"/> is attached hereto. b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4). 7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)). a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau). b. <input type="checkbox"/> have been communicated by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input type="checkbox"/> have not been made and will not be made. 8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). 9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). 10. <input checked="" type="checkbox"/> A English language translation of the annexes of the International Preliminary Examination Report under PCT Article 35 (35 U.S.C. 371(c)(5)).		
Items 11 To 20 below concern document(s) or information included:		
11. <input type="checkbox"/> An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98. 12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 C.F.R. 3.28 and 3.31 is included. 13. <input checked="" type="checkbox"/> A FIRST preliminary amendment. 14. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. 15. <input type="checkbox"/> A substitute specification. 16. <input type="checkbox"/> A change of power of attorney and/or address letter. 17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821-1.825. 18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4). 19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4). 20. <input checked="" type="checkbox"/> Other items or information. PTO-1449 and International Search Report		

U.S. APPLICATION NO. Unknown 030472 INTERNATIONAL APPLICATION NO. PCT/EP00/04676	ATTORNEY'S DOCKET NUMBER 35-222
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21. ☒ The following fees are submitted:

BASIC NATIONAL FEE (37 C.F.R. 1.492(a)(1)-(5)):	CALCULATIONS	PTO USE ONLY
-- Neither international preliminary examination fee (37 C.F.R. 1.482) nor international search fee (37 C.F.R. 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO\$1040.00 -- International preliminary examination fee (37 C.F.R. 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO.....\$890.00 -- International preliminary examination fee (37 C.F.R. 1.482) not paid to USPTO but international search fee (37 C.F.R. 1.445(a)(2)) paid to USPTO.....\$740.00 -- International preliminary examination fee (37 C.F.R. 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4).....\$710.00 -- International preliminary examination fee (37 C.F.R. 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4).....\$100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	\$ 890.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input checked="" type="checkbox"/> 30 months from the earliest claimed priority date (37 C.F.R. 1.492(e)).	\$ 130.00	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total Claims	16	-20 =	0	X	\$18.00
Independent Claims	1	-3 =	0	X	\$84.00
MULTIPLE DEPENDENT CLAIMS(S) (if applicable)					\$280.00
TOTAL OF ABOVE CALCULATIONS =				\$	1020.00

☒ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.

SUBTOTAL = \$ 1020.00

Processing fee of \$130.00, for furnishing the English Translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 C.F.R. 1.492(f)).

TOTAL NATIONAL FEE = \$ 1020.00

Fee for recording the enclosed assignment (37 C.F.R. 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 C.F.R. 3.28, 3.31). \$40.00 per property + \$ 0.00

Fee for Petition to Revive Unintentionally Abandoned Application (\$1280.00 - Small Entity = \$640.00) \$ 0.00

TOTAL FEES ENCLOSED = \$ 1020.00

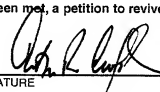
	Amount to be:	
	refunded	\$
	Charged	\$

a. ☒ A check in the amount of \$1020.00 to cover the above fees is enclosed.
 b. ☐ Please charge my Deposit Account No. 14-1140 in the amount of \$_____ to cover the above fees. A duplicate copy of this form is enclosed.
 c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 14-1140. A duplicate copy of this form is enclosed.
 d. ☒ The entire content of the foreign application(s), referred to in this application is/are hereby incorporated by reference in this application.

NOTE: Where an appropriate time limit under 37 C.F.R. 1.494 or 1.495 has not been met, a petition to revive (37 C.F.R. 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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Arthur R. Crawford
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25,327
 REGISTRATION NUMBER

January 9, 2002
 Date

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

LEIBER, J. et al.

Atty. Ref.: 35-222

Serial No. **Unknown**

Group:

National Phase of: **PCT/EP00/04676**

International Filing Date: **23 May 2000**

Filed: **Herewith**

Examiner:

For: **DATA STORAGE MEDIUM**

* * * * *

January 9, 2002

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

PRELIMINARY AMENDMENT

Prior to calculation of the filing fee and in order to place the above identified application in better condition for examination, please amend as follows:

IN THE SPECIFICATION

Page 1, after the title insert the following:

-- This application is the US national phase of international application

PCT/EP00/04616 filed 23 May 2000 which designated the U.S. --.

IN THE CLAIMS

Please substitute the following amended claims for corresponding claims previously presented. A copy of the amended claims showing current revisions is attached.

3. (Amended) The data storage medium as claimed in claim 1, characterized in that the dye comprises one or more of the substances selected from the following group: cyanines, phthalocyanines.

4. (Amended) The data storage medium as claimed in claim 1, characterized in that the refractive index of the polymer carrier (1:11) can be changed locally by heating.

6. (Amended) The data storage medium as claimed in claim 1, characterized in that the information carrier is set up so that the frequency range of a read beam for reading information from the polymer carrier (1) is different from the frequency range of a read beam for reading information from the dye layer (2).

7. (Amended) The data storage medium as claimed in claim 1, characterized in that the information carrier comprises two or more polymer carrier plies (10) through which information units may be read from a preselected polymer carrier ply (10) and, optionally, written to a preselected polymer carrier ply (10).

10. (Amended) The data storage medium as claimed in claim 8, characterized in that the refractive index of the adhesion layer (12) differs only slightly from the refractive index of the polymer carrier (11).

11. (Amended) The data storage medium as claimed in claim 1, characterized in that the polymer carrier comprises a polymer film (11).

LEIBER, J. et al.
Serial No. **Unknown**

REMARKS

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "**Version with markings to show changes made.**"

The above amendments are made to place the claims in a more traditional format.

Respectfully submitted,

NIXON & VANDERHYE P.C.

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

3. (Amended) The data storage medium as claimed in claim 1 [or 2], characterized in that the dye comprises one or more of the substances selected from the following group: cyanines, phthalocyanines.

4. (Amended) The data storage medium as claimed in [any of claims 1 to 3] claim 1, characterized in that the refractive index of the polymer carrier (1:11) can be changed locally by heating.

6. (Amended) The data storage medium as claimed in [any of claims 1 to 5] claim 1, characterized in that the information carrier is set up so that the frequency range of a read beam for reading information from the polymer carrier (1) is different from the frequency range of a read beam for reading information from the dye layer (2).

7. (Amended) The data storage medium as claimed in [any of claims 1 to 6] claim 1, characterized in that the information carrier comprises two or more polymer carrier plies (10) through which information units may be read from a preselected polymer carrier ply (10) and, optionally, written to a preselected polymer carrier ply (10).

10. (Amended) The data storage medium as claimed in claim 8 [or 9], characterized in that the refractive index of the adhesion layer (12) differs only slightly from the refractive index of the polymer carrier (11).

11. (Amended) The data storage medium as claimed in [any of claims 1 to 10] claim 1, characterized in that the polymer carrier comprises a polymer film (11).

1/PRTS

10/030472
531 Rec'd PCT/JP 09 JAN 2002

Data storage medium

The invention relates to a data storage medium having an optical information carrier which comprises a polymer carrier set up to store information.

DE 298 16 802 describes a data storage medium having an optical information carrier which comprises a polymer film. As material for the polymer film, polymethyl methacrylate and also a polymer film sold by Beiersdorf AG under the designation "Tesafilm kristallklar", which comprises biaxially oriented polypropylene, are specified. In the data storage medium, the polymer film is wound spirally in a plurality of plies onto a winding core, with an adhesion layer between each pair of adjacent plies. Information may be written to the data storage medium by locally heating the polymer film using a write beam of a data drive, as a result of which the refractive index and thus the reflecting power (reflectivity) at the interface of the polymer film are locally changed. This can be detected using a read beam in the data drive. By focussing the write beam or read beam, the information may be written to or read from, respectively, a specific preselected ply of the information carrier. The winding core may be optically transparent and may in its center have a recess which serves to accommodate the read/write device of a data drive. The read/write device is moved relative to the data storage medium, whereas the data storage medium is stationary, so there is no need for the data storage medium to be balanced to take account of rapid rotational movement.

With the existing data storage medium it is already possible to achieve very high storage densities. A further increase in the storage density is, however, desirable.

It is an object of the invention to provide a data storage medium having an optical information carrier which comprises a polymer carrier set up to store information, wherein the fundamental possibility exists
5 of an increase in the storage density.

This object is achieved by means of a data storage medium having the features or claim 1. Advantageous embodiments of the invention are evident from the
10 dependent claims. Claims 14 to 16 relate to uses of such data storage media.

The data storage medium of the invention has an optical information carrier which comprises a polymer carrier
15 set up to store information. The optical information carrier further comprises a layer which comprises a dye and can be optically changed locally in order to store information. In principle, the data storage medium may already have been written with information by the
20 manufacturer; this applies both to the polymer carrier and to the dye layer. It is, however, also conceivable to configure the optical information carrier in such a way that a user is able to input information into the data storage medium, utilizing the polymer carrier
25 and/or the dye layer.

Because the data storage medium comprises not only the polymer carrier set up to store information but also an additional layer which may be used to store
30 information, in principle a very high storage density may be achieved. Embodiments particularly advantageous for this purpose are elucidated later on.

Preferably, the dye can be at least partly bleached out
35 by means of a write beam. In this case, data (information units) can be written into the dye layer by locally bleaching out the dye in accordance with the information that is to be input, using intensive laser pulses, for example. The area for one stored

information unit typically has a diameter or a side length of approximately 1 μm . As a result of the partial or complete bleaching-out of the dye, the optical properties at the affected site change distinctly, and this may be detected by a suitable read beam. If, for example, the frequency range of the read beam is attuned to the absorption range of the dye, the absorption of the read beam at a bleached-out site is less than in its vicinity, where there is dye. If, after penetrating the dye layer, the read beam is reflected at an interface of the information carrier, therefore, a distinct read signal is produced by the bleached-out sites. Additionally, changes in the absorption activity owing to the wavelength dependency of the refractive index, which is particularly strong in the region of an absorption band, result in changes in the refractive index. This gives rise locally to changes in reflectivity, and the phase position of a read beam is also influenced. All of this may be utilized in order to obtain a read signal.

The dye may be, for example, a cyanine, a phthalocyanine or a mixture of such substances. Cyanines and phthalocyanines are currently used in writable CDs. Further examples of the dye are eosin, and eosin B. Besides the dye, the dye layer may also comprise other substances; for example, a binder - in this context, one advantageous embodiment is elucidated later on below.

In one preferred embodiment of the invention, the refractive index of the polymer carrier can be changed locally by heating. A polymer carrier having this property may be designed, for example, in the form of a stretched polymer film, which, for example, is pretensioned in two directions perpendicular to one another within its plane during production. Suitable material for the polymer film includes, for example, polymethyl methacrylate (PMMA) or, in particular,

- biaxially oriented polypropylene (BOPP), although other materials are also possible. Using a write beam, information units can be written to an information carrier comprising a polymer carrier of this kind. In the case of a stretched polymer film, a high energy density is stored in the film material. By depositing a relatively small amount of energy per unit area, using a write beam, it is then possible to obtain a sharp change in material (for example, a densification of material) by reformation, resulting in a local change in the refractive index and in a change in the optical path length in the material. In this way it is possible, for example, to achieve a change in the refractive index in the order of magnitude of 0.2 in the area locally heated by the write beam, and to do so over an area for a store information unit with a diameter or side length of approximately 1 μm . This leads to a change in the local reflectivity, which is readily detectable by means of a read beam. The details of the local optical change in the polymer carrier on storage of information therefore differ from those associated with the storage of information in the dye layer.
- 25 The polymer carrier may be assigned an absorber which is set up to absorb, at least partly, a write beam and to emit the generated heat, at least partly, locally to the polymer carrier. The absorber comprises, for example, dye molecules, which are present in the polymer carrier or in a layer adjacent to the polymer carrier, for example, an adhesion layer (see below) or else the above-elucidated dye layer, and permits a local heating of the polymer carrier, sufficient to change the refractive index, for a relatively low write beam intensity.

A further advantage of the invention is manifested if the information carrier is set up so that the frequency range of a read beam for reading information from the

polymer carrier is different from the frequency range of a read beam for reading information from the dye layer. With this embodiment it is in fact possible for the dye layer to have stored in it, or to have had stored in it, data which can be detected only using a read beam whose frequency range has been attuned, for example, to the absorption in the dye, with the dye being virtually transparent to other frequency ranges. For instance, it is possible to use such a data storage medium in a drive attuned to it which has a read device and, optionally, a write device, the read device operating with a read beam whose frequency range is set up only to read information from the polymer carrier but not to read information from the dye layer. In the dye layer, therefore, it is possible to accommodate hidden data which cannot be read with the elucidated drive, something which offers advantages in certain application environments. If, on the other hand, the data storage medium is used in a drive which has a read device and, optionally, a write device, the read device operating with read beams whose frequency ranges have been set up to read information from the polymer carrier and to read information from the dye layer, this drive can be used to recognize all of the stored data, and it is possible to utilize the advantage that the data storage medium of the invention offers a particularly high storage density.

In one preferred embodiment of the invention, the information carrier comprises two or more polymer carrier plies (preferably polymer film plies) through which data or information units may be read from a preselected polymer carrier ply and, optionally, written to a preselected polymer ply. Preferably, there is an adhesion layer between each pair of adjacent polymer carrier plies, in order to fix the polymer carrier plies to one another. A suitable adhesion agent is, for example, an acrylate adhesive which is free from gas bubbles and is crosslinked, for example,

chemically or by irradiation with UV or electron beams. If the refractive index of the adhesion layer differs only slightly from the refractive index of the polymer carrier, disruptive reflections of a read beam or write beam at a boundary layer between a polymer carrier ply and an adjacent adhesion layer are minimized. It is particularly advantageous if the difference in refractive indices is less than 0.005. An existing difference in refractive indices may, however, be utilized for the purpose of formatting the data storage medium. In one preferred embodiment, at least one adhesion layer is set up as a dye layer, which can be optically changed locally for the purpose of storing information. It is also possible for two or more, or all of the, adhesion layers between polymer carrier plies to be provided as layers of this kind for storing information. This construction of the data storage medium is particularly compact, since the adhesion layers are utilized not only for bonding the polymer carrier plies but also, at the same time, for information storage. In addition, the adhesion layers may comprise the abovementioned absorber which is set up so as to absorb heat from a write beam and emit it to the polymer carrier.

As the polymer carrier, it is possible to use plate material. As already mentioned, the polymer carrier may alternatively comprise a polymer film, made of biaxially oriented polypropylene (BOPP), for example. In this case, in one preferred embodiment the information carrier is wound in a spiral fashion, onto an optically transparent winding core, for example, which has a recess in its central region. In this case there is preferably an adhesion layer between each pair of adjacent polymer film plies or winds, said adhesion layer containing dye for the purpose of storing information. In other words, therefore, the information carrier has a coherent adhesion layer which is wound in a spiral fashion in exactly the same way as the polymer

film. For example, from 10 to 30 polymer film plies may be wound, or else a greater or lesser number. With a polymer film thickness of between 10 μm and 100 μm , preferably below 50 μm or around 35 μm , the information can be separated from one another with good resolution on different polymer film plies or on different dye plies of the adhesion layer by means of read/write devices that are known, for example, from DVD technology. The adhesion layer may, for example, have a thickness in the range between 1 μm and 40 μm , preferably below 25 μm .

If the data storage medium with spiral-wound information carrier has an optically transparent winding core which has a recess in its central area, it is possible to arrange in said recess a read device and, optionally, a write device of a drive that is attuned to the data storage medium and to move said device(s) relative to the data storage medium, while said data storage medium is stationary, in order to read or write information. A stationary data storage medium has the advantage that it does not have to be balanced in order to allow high rotational speeds, which has favorable consequences for the production costs.

In the text below, the invention is described in more detail with reference to embodiment examples. The drawings show, in

Figure 1, in parts (a) and (b), diagrammatic representations of two steps for the writing of information to a data storage medium of the invention, and in

Figure 2, a data storage medium of the invention having a spiral-wound optical information carrier, in diagrammatic perspective representation, with parts of a drive attuned to the data

storage medium disposed in a recess in the central area of the data storage medium.

Figure 1 illustrates the basic construction of the data storage medium of the invention, diagrammatically. Two plies of a polymer carrier 1 have been drawn in, with a layer 2 between them.

The polymer carrier 1 is set up to store information. It may be configured, for example, as a polymer film made of biaxially oriented polypropylene which, when heated locally, contracts in the area exposed to the elevated temperature, and changes its refractive index in that area. This leads to a local change in reflectivity and may be detected by way of a read beam, as already elucidated earlier on.

The layer 2 comprises a dye which can be optically changed locally for the purpose of storing information. Suitable dyes are, for example, cyanines and phthalocyanines which are bleached out on intensive exposure to light. Light of any frequency range which falls into the maximum of the absorption of the dye used is particularly effective. This is because, in this frequency range, depending on the concentration of the dye used, the light is to a large extent or even completely absorbed, leading to destruction of the dye and thus to a change in the optical properties of the layer 2 at the point considered, as already elucidated earlier on.

Figure 1(a) shows how three write beams 3 in the form of intense laser pulses are focussed on three sites of the layer 2 in order to bleach out the dye there and, in that way, to write information to the layer 2. The result is depicted in figure 1(b). At the three sites 4, the dye has been bleached out, which may be detected by a read beam for the purpose of reading the information.

Depending on the nature of the change in the local optical properties in the polymer carrier 1 and in the layer 2, write and/or read beams of different kinds -
5 in particular, of different power or different wavelength - are required to write and/or read information for the polymer carrier 1 and for the layer 2.

10 In figure 1(a), three write beams 3 have been drawn in. They may be used simultaneously. Also conceivable is the use of a mask which transmits the write beam light only at specified sites, or an optical imaging of an
15 intensive light source onto the layer 2, so that exposure occurs there at specified sites; write techniques of this kind are especially suitable for data storage media which are fully or partly prewritten by a manufacturer, especially in the case of a nonwound information carrier or in the case of a wound
20 information carrier prior to winding. Another possibility is to operate with a single write beam which is directed sequentially onto the desired sites in the layer 2, in respect of which an example is elucidated later on.

25

Figure 2 shows in diagrammatic representation a data storage medium D and a read/write device S of a drive that is attuned to the data storage medium D. The data storage medium D comprises a number of plies 10 of a
30 polymer film 11 which has been wound in a spiral fashion onto an optically transparent, sleeve-like winding core. For ease of comprehension, the winding core has not been depicted in figure 2; it is located inside the innermost ply 10. To aid illustration, the
35 individual plies 10 of the polymer film 11 have been shown in figure 2 as concentric rings, despite the fact that the plies 10 have been formed by winding the polymer film 11 in a spiral fashion. Between each pair of adjacent plies 10 of the polymer film 11 there is an

adhesion layer 12, the adhesion layers 12 extending spirally like the polymer film 11 and therefore being interconnected. For reasons of clarity, the adhesion layers 12 have been drawn in figure 2 in an increased thickness which is not to scale.

The polymer film 11 corresponds to the polymer carrier in figure 1 and serves as the information carrier. A further component of the information carrier is formed by the coherent adhesion layers 12, which comprise a dye, can be optically changed locally for the purpose of storing information, and correspond to the layer 2 in figure 1.

In the embodiment example, the polymer film 11 consists of biaxially oriented polypropylene and prior to winding has been pretensioned (stretched) in both surface directions. The polymer film 11 has a thickness of 35 μm in the embodiment example; other thicknesses in the range from 10 μm to 100 μm or even thicknesses lying outside this range are likewise conceivable. In the embodiment example, the data storage medium D contains twenty plies 10 of the polymer film 11 and has an external diameter of approximately 30 mm. The height of the wound cylinder is 19 mm. A different number of plies 10, or different dimensions, are likewise possible. The number of windings or plies 10 may be, for example, between ten and thirty, but may also be greater than thirty.

The adhesion layers 12 are free from gas bubbles and their base substance in the embodiment example is acrylate adhesive, to which an absorber dye has been admixed in order to make it easier, in the course of a write operation, for heat to be emitted locally to an adjacent ply 10 of the polymer film 11. Additionally, the adhesion layers 12 comprising a dye which serves for storing information by local optical change. In the embodiment example, this dye is copper phthalocyanine,

which is admixed to the acrylate adhesive in a concentration of 0.5 to 1.0% by weight and has a preferred absorptivity in the wavelength range around 658 nm. In the embodiment example, the adhesion layers 12 have a thickness of 23 μm , preferred layer thicknesses being between 1 μm and 40 μm .

It is conceivable to use phthalocyanine, for example, in the adhesion layers 12 both as an absorber dye for facilitating the local emission of heat to an adjacent ply 10 of the polymer film 11 and as dye for storing information by local optical change. If the adhesion layers 12 are sufficiently thick, in the order of magnitude of 20 μm , for example, it is possible in this case, by focussing a write beam (see below), to determine whether information is to be deposited in an adhesion layer 12 or in an adjacent ply 10 of the polymer film 11: if the write beam is focussed in the edge region of an adhesive layer 12, i.e., at a site which is close to a ply 10 of the polymer film 11, this leads to local heating in this ply 10 and thus to storage of information in the polymer film 11. If, on the other hand, the write beam is focussed in the middle region of an adhesion layer 12, the closest sites of the polymer film 11 are not sufficiently influenced for information to be stored there, but the site in the middle region of the adhesion layer 12 is optically changed, and this can be detected by an appropriately focussed read beam. With very thin adhesion layers 12, it is not possible to achieve sufficient resolution along the read or write beam by focussing; nevertheless, there is a useful application, since in this case the dye, in the course of the write operation, on the one hand provides for local heating of the polymer 11 and on the other hand is itself optically changed, so that the combined change in the relevant adhesion layer 12 and the relevant ply 10 of the polymer film 11 may be detected with particular ease by a read beam.

The read/write device S arranged in the interior of the winding core comprises a read/write head 20 which can be moved axially backward and forward and rotated in the directions of the arrows that have been drawn in, by means of a mechanism 21. The read/write head 20 comprises optical elements by means of which a beam of light (of wavelength, for example, 630 nm or 532 nm) produced by a laser, which is not shown in figure 2, may be focussed onto the individual plies 10 of the polymer film 11. Furthermore, the read/write head 20 is able to focus a beam of light produced by a separate laser, and which is absorbed preferentially by the dye present in the adhesion layers 12, onto the individual adhesion layers 12. Since the read/write head 20 is moved by means of the mechanism 21, it is able to scan fully all of the plies 10 and adhesion layers 12 of the data storage medium D. In the embodiment example, the data storage medium D is stationary. Consequently, there is no need for it to be balanced to take account of a high rotational speed (and there is also no need for it to be unwound or rewound), in contrast to the read/write head 20. For the sake of clarity, the elements provided for balancing the read/write head 20 have not been shown in figure 1. The abovementioned lasers are located outside of the read/write head 20 and are stationary; the laser beams are guided into the read/write head 20 via optical elements.

For storing or writing information to the polymer film 11 of the data storage medium D, the first of the two lasers mentioned in the preceding paragraph is operated in the embodiment example with a beam power of approximately 1 mW. The laser beam serves in this case as a write beam and is focussed onto a preselected ply 10 of the polymer film 11, in such a way that the beam spot is smaller than 1 μm , the light energy being introduced in the form of short pulses of approximately 10 μs in duration. The energy of the write beam is absorbed in the beam spot, promoted by the absorber in

the adjacent adhesion layer 12, which leads to local heating of the polymer film 11 and thus to a local change in the refractive index and in the reflectivity. During the write operation, the write beam is defocussed in the plies adjacent to the ply 10 in question of the polymer film 11, so that the adjacent plies of the polymer film 11 are only slightly heated locally and the stored information is not changed there.

Similarly, to store information in an adhesion layer 12 of the data storage medium D, the second of the two abovementioned lasers is utilized. Its write beam is focussed onto a preselected adhesion layer 12 and may likewise be operated in pulsed mode, this being done in the embodiment example using pulses with a duration of approximately 10 μ s; the initial power of the laser in the embodiment example is approximately 1 mW. In the beam spot, the dye present in the adhesion layer is bleached out. It is also conceivable to operate this laser in continuous wave mode (CW mode).

In order to read stored information from the data storage medium D, the lasers are operated in continuous wave mode (CW mode). Depending on the stored information, the respective read beam focussed onto the desired site of the polymer film 11 or of an adhesion layer 12 is reflected, and the intensity of the reflected beam is detected by a detector in the read/write device S.

The data storage medium may also be of an embodiment which cannot be written by the user. In this case it contains information units which have been written by the manufacturer to the polymer carrier 1 and/or the layer 2. In this case, there is no need for a write function in the user's data drive.

Furthermore, the drive may only comprise a read device

and, optionally, a write device for reading and, respectively writing information from and to the polymer carrier 1, respectively. In that case, data input into the layer 2 by, for example, the manufacturer of the data storage medium or by another user, by means of a different drive, cannot be recognized, the reason being, for example, that the layer 2 are transparent virtually everywhere for the frequency range or wavelength range of the read beam used. This offers advantages for some applications.

The information units in the polymer carrier 1 or the polymer film 11 have been formed by changing the optical properties in an area having a preferred size of less than $1\text{ }\mu\text{m}$. The information may have been stored in binary form; i.e., the local reflectivity adopts only two values at the site of an information unit. In other words, if the reflectivity lies above a fixed threshold value, a "1", for example, is stored at the site in question on the information carrier, and, if it lies below this threshold value or below a different, lower threshold value, a "0" is stored correspondingly. It is, however, also conceivable for the information to be stored in two or more gray stages. This is possible if the reflectivity of the polymer film at the site of an information unit can be changed in a specific way by defined adjustment of the refractive index without saturation being reached. In principle, data may be stored in the layer 2 and/or in an adhesion layer 12 in ways which are analogous to these possibilities.

New Claims

1. A data storage medium, having an optical information carrier which comprises a polymer carrier (1), which is set up to store information, and, further, as an information storage layer independent of the polymer carrier (1), a layer (2) which comprises a dye and can be optically changed locally for the purpose of storing information.
2. The data storage medium as claimed in claim 1, characterized in that the dye can be at least partly bleached out by means of a write beam (3).
3. The data storage medium as claimed in claim 1 or 2, characterized in that the dye comprises one or more of the substances selected from the following group: cyanines, phthalocyanines.
4. The data storage medium as claimed in any of claims 1 to 3, characterized in that the refractive index of the polymer carrier (1; 11) can be changed locally by heating.
5. The data storage medium as claimed in claim 4, characterized in that the polymer carrier (1; 11) is assigned an absorber which is set up to absorb, at least partly, a write beam and to emit the generated heat, at least partly, locally to the polymer carrier (1; 11).
6. The data storage medium as claimed in any of claims 1 to 5, characterized in that the information carrier is set up so that the frequency range of a read beam for reading information from the polymer carrier (1) is different from the frequency range of a read beam for reading information from the dye layer (2).

7. The data storage medium as claimed in any of claims 1 to 6, characterized in that the information carrier comprises two or more polymer carrier plies (10) through which information units may be read from a preselected polymer carrier ply (10) and, optionally, written to a preselected polymer carrier ply (10).
8. The data storage medium as claimed in claim 7, characterized in that there is an adhesion layer (12) between each pair of adjacent polymer carrier plies (10).
9. The data storage medium as claimed in claim 8, characterized in that at least one adhesion layer (12) is set up as a dye layer which can be optically changed locally for the purpose of storing information.
10. The data storage medium as claimed in claim 8 or 9, characterized in that the refractive index of the adhesion layer (12) differs only slightly from the refractive index of the polymer carrier (11).
11. The data storage medium as claimed in any of claims 1 to 10, characterized in that the polymer carrier comprises a polymer film (11).
12. The data storage medium as claimed in claim 11, characterized in that the information carrier (11, 12) is wound in a spiral fashion.
13. The data storage medium as claimed in claim 12, characterized by an optically transparent winding core which has a recess in its central region.
14. The use of a data storage medium as claimed in claim 6 in a drive which is attuned to it and

comprises a read device and, optionally, a write device, the read device operating with a read beam whose frequency range is set up only for reading information from the polymer carrier (1) but not for reading information from the dye layer (2).

15. The use of a data storage medium as claimed in claim 6 in a drive which is attuned to it and comprises a read device (S) and, optionally, a write device (S), the read device (S) operating with read beams whose frequency ranges are set up for reading information from the polymer carrier (11) and for reading information from the dye layer (12).
16. The use of a data storage medium as claimed in claim 13 in a drive which is attuned to it and comprises a read device (S) and, optionally, a write device (S), the read device (S) and the optional write device (S) being arranged in the recess in the central region of the winding core and being moved relative to the data storage medium (D), while the data storage medium (D) is stationary, for the purpose of reading and/or writing information.

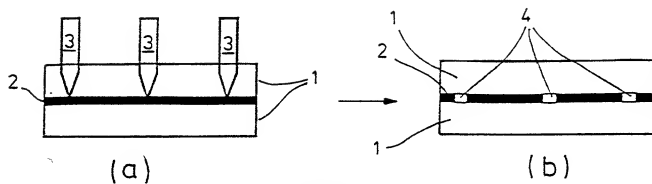


FIG. 1

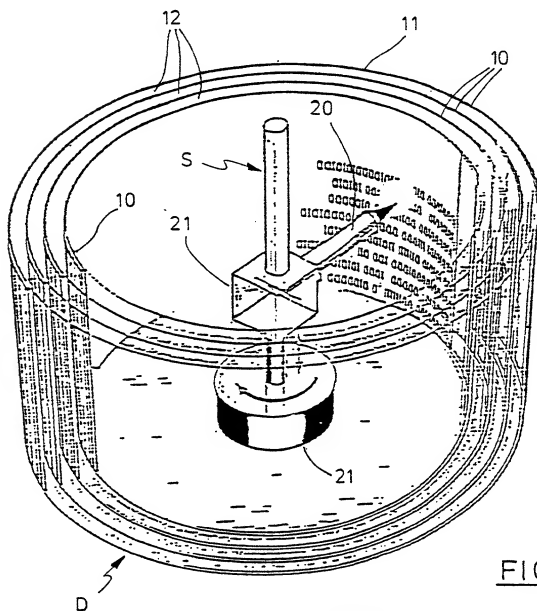


FIG. 2

**RULE 63 (37 C.F.R. 1.53)
INVENTORS DECLARATION FOR PATENT APPLICATION
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

As a below named inventor, I hereby declare that my residence, mailing address and citizenship are as stated below next to my name, and I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

DATA STORAGE MEDIUM

the specification of which (check applicable box(es)):

☐ is attached hereto
☐ was filed on _____ as U.S. Application Serial No. _____ (Atty Dkt. No. 35-222)
☒ was filed as PCT International application No. PCT/EP00/04676 on 23/05/2000
and (if applicable to U.S. or PCT application) was amended on _____

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose to the Patent Office all information known to me to be material to patentability as defined in 37 C.F.R. 1.56. I hereby claim foreign priority benefits under 35 U.S.C. 119/365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed or, if no priority is claimed, before the filing date of this application:

Priority Foreign Application(s):	Country	Day/Month/Year Filed
Application Number 199 32 902.8	DE	12/07/1999

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

Application Number	Date/Month/Year Filed

I hereby claim the benefit under 35 U.S.C. 120/365 of all prior United States and PCT International applications listed above or below.

Prior U.S./PCT Application(s):	Day/Month/Year Filed	Status: patented pending, abandoned
Application Serial No. PCT/EP00/04676	23/05/2000	

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon. And on behalf of the owner(s) hereof, I hereby appoint **NIXON & VANDERHYE P.C., 1100 North Glebe Rd., 8th Floor, Arlington, VA 22201-4714, telephone number (703) 816-4000 (to whom all communications are to be directed)**, and the following attorneys thereof (of the same address) individually and collectively owner's/owners' attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith and with the resulting patent: Larry S. Nixon, 2564; Arthur R. Crawford, 25327; James T. Hosmer, 30184; Robert W. Faris, 31352; Richard G. Besha, 22770; Mark E. Nusbaum, 32348; Michael J. Keenan, 32108; Bryan H. Davidson, 30251; Stanley C. Spooner, 27383; Leonard C. Mitchard, 29009; Duane M. Byers, 33444; Jeffrey H. Nelson, 30484; John R. Lastova, 33149; H. Warren Burnam, Jr., 29366; Mary J. Wilson, 32955; J. Scott Davidson, 33448; Alan M. Kagen, 36178; Robert A. Molan, 29834; B. J. Sadoff, 36653; James D. Berquist, 34776; Updeek S. Gill, 37334; Michael J. Shea, 34725; Donald L. Jackson, 41080; Michelle N. Lester, 32341; Frank P. Probst, 19828; Joseph S. Presta, 35328; Joseph A. Rhoads, 37518; Raymond Y. Mah, 41426; Chris Comuntzis, 31097; Gary T. Tanigawa, 43100. I also authorize Nixon & Vanderhye to delete any attorney names/numbers no longer with the firm and to act and rely solely on instructions directly communicated from the person, assignee, attorney, firm, or other organization sending instructions to Nixon & Vanderhye on behalf of the owner(s).

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☒ See attached sheet(s) for additional inventor(s) information!!

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Serial No.

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3.

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